Letter of Interest: **The IsoDAR Cyclotron as a Testbed for Next-Generation Isotope-Production Targets**

Primary Frontier: Community Engagement / Applications & Industry **CommF**1
Additional Frontier: Accelerators / Technology – targets, sources **AF7**

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Cyclotron-based medical isotope production has a bottleneck in target design: today's targets are incapable of handling more than a few kilowatts of beam power. Dedicated isotope cyclotrons, such as the IBA C-70 at ~50 kW [1], already overwhelm existing production targets. This limitation affects the efficiency of production of promising isotopes. Targets capable of using more of the available beam current would enable increased production and lower cost of nuclear medicine procedures.

Cyclotron technology is advancing at a rapid pace. In particular, the development of the 10 mA, 60 MeV H_2^+ compact cyclotron as the driver for the neutrino source for the IsoDAR experiment [2,3] represents a factor of 10 more power on target than even the industry-leading C-70. Application of this cyclotron for medical isotope production could enable very substantial advances in the field [4,5]. One envisions dramatic production increases in low-cross section reactions (e.g. ^{225}Ac), long-lived parents of generators (e.g. ^{68}Ge/Ga, ^{82}Sr/Rb), and higher saturation activity levels for shorter-lived isotopes offsetting losses in transportation to use-sites.

However, these gains are attainable only if targetry or beam-delivery techniques can make use of the full capabilities of the cyclotron.

Developing higher-power isotope targets is a difficult problem, because of the complex chemistry required to isolate the desired product, and the need to minimize chemical reagents that become a high-level radioactive waste stream. Nonetheless, the economic and societal gains from successful R&D in this area are unquestioned, and such efforts should be supported with high priority.

Another method of increasing beam utilization is by splitting the beam so as to service several targets simultaneously. Conventional isotope cyclotrons, accelerating H^-, utilize stripping extraction. It is possible to use multiple strippers to peel off portions of the internal beam to different extraction ports. However, in practice it is difficult—and impractical—to tune the beam to balance output current with more than two stripping stations. As described in [5], the IsoDAR cyclotron, by virtue of accelerating and extracting H_2^+ ions, has several ways of splitting off portions of the beam to irradiate several targets at the same time. In such a configuration, several stations could be used with existing target technology to enable production of isotopes at present levels of efficiency, while the remaining

beam is sent to research stations where higher power target-development projects are underway. As new higher-power targets became available, they could be put in service with a higher fraction of the beam, thus providing immediate gains in productivity.

As an example of the benefits of higher currents, full utilization of the IsoDAR cyclotron beam could produce 50 curies per week of the 270-day ^{68}Ge parent of the PET isotope ^{68}Ga generator. This could yield a very large number of generators, typically 50 millicuries each, with a useful lifetime of over a year.

It is our belief that the IsoDAR cyclotron can become an extremely valuable tool for the medical isotope industry, not only to enable the development of new higher-power targets, but ultimately to demonstrate the economic and scientific benefits that higher beam currents will enable.

REFERENCES

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